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Kingston Medical Quarterly

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KINGSTON MEDICAL QUARTERLY.

Vol. VII. JULY, 1903 No. 4.

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DOMINION MEDICAL REGISTRATION.

DURING the session of 1902 the Dominion Parliament passed the Dominion Medical Act which created the Dominion Medical Council and gave to it on certain conditions certain powers. Among the other powers granted to the Dominion Medical Council was the power to grant a license to practise medicine in any part of our Dominion, providing the candidate for license paid the fee required by the Province in which he proposed to practise. This Act of the Dominion Parliament was not to become operative until it received the sanction of all the Provinces of Canada. So far all the Provinces

have signified their approval of the Act and have taken the steps necessary to obtain the required legislation except the Province of Quebec. In that Province a Bill providing for the acceptance of the Act was introduced in the Legislature and on April 15th last the Bill was defeated. This meant that the Act of the Dominion could not become operative in any part of the Dominion as it requires the endorsation of all the Provinces before it comes into effect.

The question naturally arises why was the Bill defeated by the Quebec Legislature. The profession and at least one of the Universities of Quebec are opposed to the provisions of the Dominion Medical Act. Why? At present anyone holding a degree in Medicine from any of the Quebec Universities is, on payment of the necessary fees, entitled to receive the License of the Medical Council of Quebec. According to the provisions of the Dominion Medical Act the holding of a degree in Medicine from any University does not entitle one to receive the Dominion License. This is a wise provision and one upon which the other Provinces and the Canadian Universities other than those of Quebec and, perhaps that of Manitoba, will insist. If University degrees were to be accepted and the Dominion License granted to the holders thereof there would be no uniformity in the qualifications required by the Dominion Council. All the other Provinces insist on there being a uniform standard for all those who wish to obtain the Dominion License. With this contention we most emphatically agree and we are strongly of opinion that rather than have University degrees accepted as a qualification for the License we would rather see no Dominion Council at all. There should be and there must be but one course and one series of examinations for all who wish to secure the License of the Dominion Medical Council.

After the Bill suffered defeat in the Quebec Legislature the Montreal Medical Society took the matter up and considered what could be done to secure Dominion Medical Registration in the face of the set back which it received from Quebec. A special committee was appointed to consider the whole matter and the report of this committee was adopted at a subsequent meeting held on March 31st last. This report suggested

several amendments to the Dominion Medical Act. Most of these were unimportant and do not require consideration. The third amendment suggested is of a different nature and if it were incorporated in the Act would so completely alter its character that it could not be accepted by the other Provinces. This proposed amendment reads as follows:—

"Only those will be admitted to pass their examinations who are licensed doctors in one of the provinces of the Dominion, or of a foreign university, duly recognized by the laws of their respective countries."

It is safe to say that if such an amendment were made to the Act the Act would never be endorsed by the Provinces other than Quebec and possibly Manitoba. What would such an amendment mean? It would simply mean that graduates of the Quebec Universities who on the production of their degrees are granted the Quebec License could proceed at once to take the examinations of the Dominion Medical Council while graduates of the other Provinces except those of Manitoba would first have to go up for and pass the examinations of the Council of their respective Provinces before they would be allowed to take the examinations of the Dominion Council. This would at once create a condition favourable to the graduates of the Universities of Quebec and Manitoba and disadvantageous to the graduates of the Universities of all the other Provinces. Before obtaining the License of the Dominion Medical Council a graduate of, say a University in Ontario, would have to go up and pass three sets of examinations — that of his University, that of the Provincial Council and that of the Dominion Council. On the other hand a graduate of any one of the Quebec Universities could obtain the Dominion License by passing two sets of examinations — that of his University and that of the Dominion Council. This is such a manifest injustice to the graduates of the Ontario Universities that one can hardly conceive how any body of supposedly intelligent men could even suggest such an amendment much less how they could ever hope that such an amendment would be accepted by the other Provinces or endorsed by the Dominion Parliament. The advocates of this suggested amendments may as well make up

their minds at once that the rest of the Dominion will never accept an amendment which unduly favours the graduates of one Province and so prejudicially affects the graduates of other Provinces. We feel quite certain also that the Dominion Parliament will never pass such a monstrously unfair amendment, and we feel perfectly safe in predicting that even if the amendment were passed the Act would never receive the endorsation of the other Provinces. We ask nothing for the graduates of the Ontario Universities which we are not willing to grant to the graduates of all Canadian Universities but we will most strenuously oppose granting to the graduates of the Quebec Universities favours which are withheld from our own Ontario graduates. Some other solution of the present difficulty must be found than that proposed by the Montreal Medical Society which is mainly characterized by favouritism to Quebec graduates and injustice to the graduates of all the other Provinces with the exception of Manitoba.

CANCER OF THE UTERUS.

CANCER of the uterus may arise from any portion of the uterine mucosa, both within the uterus itself and covering the vaginal portion of the cervix. According to the anatomical situation it may be classified as,—1, Cancer of the vaginal portion of the cervix, including the vaginal surface, from the external os to the vault of the vagina;—2, Cancer of the cervix, including the cervical canal;—3, Cancer of the body of the uterus, from the internal os to the fundus.

Causes. The actual determining cause is still a matter of theory. We find cancer of the uterus appearing about the time of the menopause; cancer of the vaginal portion often just before the menopause, and cancer of the body usually a few months or a few years later. Most cases occur between the ages of 50 and 70 years. Heredity used to be claimed by some as an etiological factor, but is not now considered of as much

importance as was formerly the case. Childbearing seems to have an important influence on the production of cancer of the cervix ; this variety of cancer being very rare in nulliparæ, and relatively frequent in those who have borne children, and especially in those who have lacerations of the cervix. This speaks for the influence of trauma and irritation as a causal agent. Recently Leopold claims to have found pure cultures of the blastomycetes in fresh carcinoma of the ovary, and by injection of a pure culture into the testicle of a rat he claims to have produced on the peritoneum nodules in which similar blastomycetic organisms were found. From these experiments he infers that this organism may be the cause of carcimoma in man.

Clinically, we may divide cancer of the cervix into four classes, (1) Cauliflower carcinoma of the vaginal portion of the cervix. This form tends to grow superficially into the vagina and is seen as a sessile or pedunculated growth arising from one or both lips of the cervix. It may be of any size up to completely filling the vagina. The surface is uneven, nodular or polypoid, covered with a slimy gangrenous deposit. The whole mass bleeds readily to the touch and is very friable. (2) Infiltrating or Nodular cancer. This form appears in the early form as an irregular thickening of the cervix. It may appear on either the anterior or the posterior lip, but most frequently the anterior lip is first involved. In this form the whole cervix soon becomes involved. Before disintegration the surface is hard friable and uneven. Later in the disease as disintegration sets in, we find an ulcer with hard, elevated margins, and rough uneven base, covered with a stinking slough, of a dirty yellow or gangrenous character. This bleeds very readily on handling. The growth may now spread to the vaginal walls, producing extensive ulceration, or it may pass beyond the internal os into the cavity of the uterus. The pelvic connective tissue, broad ligaments and utero-sacral ligaments are infiltrated relatively early. The bladder is involved late, and the rectum still later as a rule. Only in the very late stage is the peritoneum invaded. (3) Cancer of the cavity, Boring or Eating cancer. This form develops first in the mucous membrane of the cervix.

It may assume a nodular appearance or the whole cervix may be infiltrated. This soon ulcerates and slowly the part disintegrates till finally in some cases only a thin shell remains. The body of the uterus may be invaded early by direct extension or by metastasis, and soon the periuterine connective tissue is also involved. The vagina may not be involved till late or not at all (4) Vaginal cancer. This form may be an extension of the infiltrating form or it may be regarded separately as beginning in the posterior cul-de-sac and invading equally the cervix and adjacent portions of the vagina. Usually there is extensive ulceration and destruction of tissue. It has then, all the characteristics of a malignant ulcer, and from its greater accessibility to touch and sight is more easily recognized than any of the other forms.

Cancer of the body of the uterus may arise from any part of the uterine mucosae either as a circumscribed or as a diffuse growth. It is here almost always columnar celled or adenocarcinoma, arising as it does in the tubular glands of the mucous membrane lining the cavity. Very rarely a squamous celled cancer of the body of the uterus is met with, but few authentic cases have been reported. Cancer in this situation as a rule remains for a long time restricted to the body of the uterus. The muscular coat of the uterus is only slowly invaded. Eventually it may creep into one or both tubes. The broad ligaments are not invaded till late. The bladder and rectum may escape altogether.

Clinical Diagnosis. Perhaps we may say that in this disease more than in any other, that, to be of any benefit to the patient early diagnosis is imperative; and as the early symptoms of the disease are of such a vague and indefinite nature it is the duty of the family physician to be ever on the alert for the earliest signs of trouble here. To aid in the early diagnosis perhaps no better rule can be, at present, advanced than to regard every menstrual irregularity or hemorrhage occurring in patients of advanced years, as suspicious of carcinoma and demanding a thorough search into its cause.

The first sympfom then to put us on our guard is hemorrhage. The patient has noticed some slight departure from the

normal menstrual flow at or about the menopause. This may be a small loss of blood at other than the regular period, or appearing at variable times after the menopause. It is at first excited by some physical exertion such as, straining at stool, lifting some weight, or it may come on after sextual intercourse.

Leucorrhoea is almost always present, at first watery and odorless, then becoming thicker and yellowish, and finally of a dirty bloody reddish nature, with a peculiar, characteristic, as well as a disgusting odor.

Pain may not be present. Frequently cases occur where the disease is very far advanced before any pain is experienced. If the pelvic connective tissue is involved there may be referred pain in the groin, thighs, etc. In such cases there may be also oedema of the legs from venous or lymphatic involvement. Cachexia only occurs late in the disease.

On examination, if the cervix is the part involved, the examining finger may detect a hard, irregular nodular surface, which when gouged by the finger nail, or caught with a tenaculum, is found to be quite friable, and to bleed very readily. If this mass has begun to ulcerate there is little doubt as to the diagnosis of infiltrating, or nodular cancer. If any doubt exists a small scraping should be submitted to microscopic examination.

The cauliflower cancer is much more readily recognized, although it may be mistaken for papillary erosion. On examination of a well marked case the examining finger encounters an irregular friable mass, feeling not unlike soft boiled cauliflower. If any doubt exists a small piece of the suspected growth should be submitted to microscopic examination.

The early diagnosis of cancer of the cavity of the cervix is not so easy on account of its non-accessiblity to the sense of touch or sight. The growth may go on to quite an advanced stage before trouble is even suspected. If there has been much destruction of tissue the speculum may reveal the nature of the trouble. Early in the disease, however, nothing may be noticed until the cervical canal has been explored. On dilating the cervix bleeding is profuse and the part is seen to have that characteristic friability peculiar to cancer.

Cancer of the body of the uterus presents a much more difficult diagnosis. The patient may complain of little or nothing. The first thing noticed may be an occasional fitful hemorrhage after the menopause. This may be followed by a foul smelling dlscharge, of a thin, watery, consistency and of a color not unlike strawberry juice. Later on pain may be experienced. The cancerous cacexia may be absent till the very last stage of the disease.

To recognize the trouble early then, on the first appearance of menstrual irregularity or hemorrage after the menopause a thorough examination of the uterus should be made both by bimanual palpation and exploration of the uterine cavity itself. The bimanual examination may possibly show the uterus to be somewhat enlarged, but this symptom is not to be relied on in itself. A peculiar inelastic or boggy sensatlon is at times present and is fairly characteristic. If the disease has extended to the peritoneal surface an irregular nodular surface may be felt. On exploring the uterine cavity with a sound the instrument will be found to sink into the soft growth and cause considerable hemorrhage. The irregular surface and friabiiity of the growth are not as readily or as certainly recognized wiih the sound as they are with the examining finger. For this reason it is well to dilate the cervix enough to allow of the introduction of the finger into the uterine cavity. Sufficient tissue may be scraped off by the examining fingernail for the purpose of making microscopic diagnosis, or a curette may be used where the finger fails.

In all cases where the slightest doubt exists as to the nature of a uterine growth in a patient who has passed the menopause, a microscopic examination of excised pieces or of scrapings removed by the curette should be made, as by this means only can an early positive diagnosis of cancer be made.

Treatment to be of any real benefit to the patient must be begun before the disease has had a chance to spread to the surrounding tissues. The uterus should be freely movable and unassociated with severe pelvic pains. Where such is the case, complete exterpation of the uterus should be proceeded with at once. Where there has been a spread of the trouble to

the neighboring organs and tissues, radical operation is contradicted, as even when performed under the most favorable local surroundings and by the most skilled and dexterous operators no benefit results, the disease returning rapidly and metastasis to other organs being stimulated. There are good pathologists who claim that, where cancer occurs primarily in the cervix, even when a fairly early diagnosis has been made, return within a very short period is almost certain, irrespective of the thoroughness of the operation.

As opposed to this view, there are some operators of good repute who claim non-return of cancer of the cervix, ten years after removal by high amputation of the cervix. In such cases the operation was performed in the very earliest stages of the disease before any lymphatic envolvement had taken place.

As a general rule we may say that nothing short of complete hysterectomy can be of any permanent benefit. It must of course be left to each individual operator whether he setects the vaginal, the abdominal or the combined vagino-abdominal route.

As for those cases where the disease has so far advanced as to preclude any hope of permanent benefit resulting, the thermo cautery and the electro cautery may be used with a view to removing a very offensive local condition and so rendering the few remaining years of the patient's life more comfortable and less offensive to herself and to her friends.

G. F. Dalton.

THE DYSPHAGIA OF TUBERCULOSIS.

THERE is no symptom in tuberculosis which is the cause of more suffering and distress than the dysphagia which is so frequently present in the laryngeal type of the disease. The problem of feeding is rendered doubly urgent and is not easily solved.

The act of deglutition is the cause of the pain which results from ulceration about the epiglottis, pharyngeal walls, arytenoids or in the aryepiglottic folds. These situations are exposed to contact with food during its passage into the oesophagus or are directly concerned in the function of swallowing. When the ulceration is entirely within the larynx, on the vocal cords, ventricular bands, or on the posterior wall of the larynx, dysphagia is not present. When the epiglottis is much involved its mobility is impaired and as a result of its fixation there is also trouble from liquids and food entering the larynx during deglutition. Then a spasm is set up, food is regurgitated and may pass through the nose. So the dirtress is increased and the patient becomes more and more unwilling to take nourishment in the usual way. The disastrous effects of dysphagia are very quickly manifest in impaired nutrition, not only from interference with ingestion of food but also from the depression of the nervous system resulting from frequently recurring pain.

The indications in dealing with this condition are, then, to secure rest for the parts, to avoid any movement which produces pain, to protect the parts from injury and to maintain nutrition. It is impossible to inhibit the act of deglutition though it may be reduced in frequency. When the pain is intense the patient resists swallowing to get rid of secretion and refuses food even though hungry. I have known patients refuse all food for twenty-four hours rather than suffer the pain produced by swallowing. It is necessary then, at the earliest possible moment after dysphagia is present to administer only highly concentrated food of such a character that it is ingested with the least possible discomfort and with the fewest acts of

deglutition. There are two methods by which nutrition may be maintained without the performance of deglutition. First by rectal alimentation and second, by the use of an oesophageal tube. The value of the first method is so well established that it is unnecessary here to enter into any details of the procedure. Its early adoption in these cases is essential. The second method is useful in many cases where the stomach is in good condition and there is a craving for food. A soft rubber catheter of small size should be used and not the ordinary large oesophageal tube. The catheter is attached to a glass funnel. The tube need not be passed into the stomach but only beyond the pharyngeal constrictors, In this way an unlimited amount of food may be introduced with no discomfort other than that caused by the passage of the tube. A little practice may render this easy and painless. The tube should be lūbricated with white of egg, milk, or mucilage, and not with vaseline, glycerine or oil which are very unpleasant to the patient and may even of themselves produce nausea. Some patients prefer to swallow slowly just before the passage of the tube a small quantity of thick mucilage, the protection afforded by this being very satisfactory. The usual method of passing the tube may be employed except that the finger is not necessary as a guide. There is little risk of the larynx being entered. Care should be taken to avoid all points of tenderness. In many cases the patient himself will soon learn to pass the tube more easily than it can be done for him, since no one knows so well the site of the painful points. Sometimes the tube may be passed through the nostril with greater satisfaction. When the tender points are on the fauces or epiglottis they may be avoided by this route. Food introduced in this way must be liquid or semi-liquid, and should be concentrated as much as possible. The selection of foods cannot be given too much consideration, whether it is to be taken by the mouth in the usual way or by the tube. All who have had to deal with these cases must have noticed how rapidly the weakness progresses as soon as dysphagia sets in, and how soon the patient dies from inanition. So long as the patient is able to take the ordinary diet he should do so, special food being used in addition. When the pain is

not great a spray of chloretone used ten minutes before the meal will allow it to be taken in comfort. I use a solution of chloretone, five grains to the ounce with just enough rectified spirit added to disolve the chloretone. This can be used very freely without fear of any constitutional effects and for some of my patients has been very satisfactory. Cocaine solution may be used in the same way, but it is often disappointing in its action. Orthoform by insufflation is fairly satisfactory as where it gives relief it is often of much longer duration than from the other anaesthetic applications. Morphia by insufflation is of litle use, as it has little if any local action. When the time comes to give these patients morphia I consider it much better to give it by hypodermic injection.

The special foods should be abundant in quantity—as much as can be digested and as nutritious as possible. Eggs, milk and cream are the best. In temperature they should be but a few degrees above the body temperature, though sometimes a patient will prefer iced foods. Semi-solids are most easily swallowed, so all liquids should be thickened, and broths and soups made of the same consistency. Alcohol in any form is usually refused because of the pain produced. It may be given by the rectum. The Debove method of forced feeding is highly recommended in this as in pulmonary tuberculosis. This consists of one litre of milk, one egg, and one hundred grams of finely powdered meat given three times a day.

Wolfenden recommends swallowing by sucking through a rubber tube or a straw while lying prone on the face with the feet slightly raised. I have seen but one patient who was benefited by this suggestion.

As to heroic treatment for the relief of dysphagia I have never seen any benefit from it. My practice is to see these cases daily, to cleanse the throat thoroughly by sprays and applications or by a laryngeal syringe. Then to use a local anaesthetic by direct application and to follow this by a swabbing with alcohol. After this treatment my patient usually takes a meal without discomfort.

Lactic acid is not of use for the cases of dysphagia. The galvano-cautery is recommended but so much oedema has

followed its use in my experience that I do not employ it in cases of ulceration. Curetting also has its advocates but I do not use it. Tracheotomy or intubation may be necessary for relief of oedema of the glottis but would scarcely be justified for dysphagia. Gastrostomy has been performed and may be justified in exceptional cases. The entire epiglottis has been removed by the cautery snare.

Sooner or later the time comes when the patient can be made comfortable by morphia alone, and while there is little doubt but that its use hastens the end, surely these are cases in which it is our duty to promote euthanasia.

J. C. Connell.

OTITIS MEDIA IN TYPHOID FEVER.

DURING the recent epidemic of typhoid fever ten cases of purulent otitis media came under my care and as the proportion seemed unduly high I have endeavored to compare the percentage with that on record in recent literature. The statistics of Hengst are probably the most recent and conclusive. By means of a circular letter he collected an aggregate of 1,228 cases of fever. Twenfy eight cases of purulent otitis media were reported, on an average of 2.28 per cent. Hospital cases gave an average of 2.6 per cent; cases in private practice, 1.9 per cent. Thus it would appear that ear complications are more common among hospital cases.

Eight of my ten cases were in the General Hospital, one was seen in a private house and one in the Hotel Dieu. The epidemic continued for about four months during which 59 cases were treated in the General Hospital. This gives a per-

centage of 12.38 which is certainly remarkable high.

Keen has collected 31 cases making a total with those of Hengst of 59. No death is recorded among the 59 although many of the cases were protracted and severe. In my list of ten cases there were two deaths, one from exhaustion and the other from meningitis. Mastoiditis is reported in one of Hengst's 28 cases, but it was evidently superficial as it was quickly relieved by Wilde's incision. In none of my cases was the mastoid involved, there being slight tenderness over the mastoid in one case only for two days. All the 28 cases of Hengst terminated in recovery of the hearing without chronic discharge. In only one of my cases that recovered was the hearing impaired and in this case the discharge became chronic.

The complication developed in the third or fourth week of the fever and was apparently responsible for continued high temperature for a period of from one to two weeks. There can be no doubt that the retention of nasal and naso-pharyngeal secretions in the naso-pharynx at a time when the patient is too weak to expel them is the cause of the trouble. In almost every case there was more or less epistaxis for a few days previous to the development of the ear symptoms. Under these conditions pyogenic bacteria will develop rapidly in the naso-pharynx and will tend to invade the middle ear by way of the Eustachian tube. Brannan in his article on Typhoid Fever in the Twentieth Century Practice, quoting Hengst, thinks it possible that some cases are caused by cold draughts of air on the side of the head, or by the entrance of cold water into the external meatus when the patient is being bathed. For my part, I do not think that these can be regarded as possible causes. In many cases catarrhal inflammation of the middle ear was present for a few days before suppuration took place. This probably extended by continuity from the naso-pharyngeal membrane. Treatment in this early stage failed in every case to avert suppuration. In all cases but one both ears were affected and the deafness was profound. When once resolution set in recovery was rapid and hearing was quickly restored.

The interest in these cases is mainly in connection with

prophylaxis. When the lesion develops the treatment must be much the same as in ordinary cases of purulent otitis media. I think it most important to keep the nose and naso-pharynx clear throughout the progress of the fever. This is all the more necessary when the patient is prostrated so that he is unable to make the effort necessary to expel the secretions. The use of mild antiseptic solutions through the nose with a medicine dropper does not disturb the patient but is really very grateful. The solution and secretions may not be expelled but pass into the oesophagus. This can do no harm. The solutions most suitable for the purpose are listerine or euthymol, 1 in 8; boracic acid in saturated solution; or a solution of bicarbonate of soda, five grains, permanganate of potash, one tenth grain, to water one ounce. The use of such solutions also tends to prevent the epistaxis which is commonly due to picking the nose with the finger to relieve the itching or to remove the dry crusts of secretion.

J. C. Connell.

Regional Minor Surgery, by Geo. Gray Van Schaick, published by *The International Journal of Surgery Co.*, 100 William Street, New York. $1.50 net.

This book is a valuable addition to the list of works on Minor Surgery. The writer keeps before him the character of the work he has undertaken and has thus succeeded in providing a book that should be of great value to the general practitioner. The opening chapter deals with asepsis in a very complete and concise manner. Suturing which if carelessly done mars the result of otherwise good surgery is discussed in the second chapter. Following these the lessons that may be roughly grouped under the title of Minor Surgery, are discussed under the various regions in which they may occur. The treatment is well described and up to date, and much of it is the resul of years of patient observation and practice by the author himself, and many points will be found to bear the impress of his originality.

THE WIDAL OR SERUM REACTION IN TYPHOID FEVER.

(Read at June 1903 Meeting Kingston Medical and Surgical Society.)

THOUGH the serum reaction in cases of typhoid infection was not discovered by Widal, but was first recognized by Pfeiffer, and more thoroughly studied by Gruber and Durham in inoculated animals and by Grumbaum in typhoid in man, yet as Widal first published and made the reaction applicable to the diagnosis of typhoid fever in man, the reaction commonly goes by the name of the Widal test. To the late Wyatt Johnston of Montreal is due the credit of showing that the test could be made from dried blood and so gave the reaction at once a wide clinical application owing to the ease with which blood drops can be secured and kept or sent for examination.

The principles upon which the reaction is based, consist in the fact that in many infections, whether experimental or natural, there is a reactive change on the part of certain tissue cells of the infected individuals, leading to the production of bodies which posses an agglutinative action when brought into contact with a culture of the infecting agent. In a paper read before this society in October last I shortly outlined the method in which these agglutinins were believed to be formed as a result of cellular activity under the stimulus of the infecting agent. These bodies are not met with in all forms of infection, nor, when one considers the widely differing methods of action of the various infecting agents, could one expect to note the constant development of such a phenomenon. The production of agglutinins is not confined to certain bacterial infections but is seen e.g. following inoculations of blood of one species of animal into another species, when the serum of the inoculated animal is brought into contact with some of the blood used for the inoculation. The commoner bacterial infections in which we find the development of specific agglutinins are typhoid fever, bacillary dysentery, paracolon fever, malta fever and to a lesser extent plague and tuberculosis. In the first four mentioned the presence of the agglutinins is made use of as a means of diagnosis. No direct relationship can be traced between the agglutinins and the production of immunizing substances in

so far as the individual is concerned at least. While a blood serum is not infrequently met with in typhoid which contains besides the agglutinins, bodies having a distinct destructive or bacteriolytic action on the typhoid bacillus, still as a rule such bodies are present in small amount even in cases progressing to a favorable issue and may be absent entirely in other cases where serum shows marked agglutinative power. The agglutinative reaction is now looked upon entirely as a "reaction of infection" and as such, due to the reactive change called forth by the presence of the infecting bacteria in the system.

The time of appearance of the agglutinin in typhoid varies in different cases. It is very seldom found before the 5th day, generally it makes its appearance on 7th day of the fever. The reaction will be found present in at least 80 per cent of all cases before the end of the second week. Its absence, however, cannot be positively stated until it has been repeatedly looked for up to end of febrile period as a small percentage of undoubted typhoid cases show a marked delay in its development and indeed in a few cases it is entirely absent. However, in at least 94 per cent of cases this reaction is present at some period of the fever. Not only does the test fail in a few cases of typhoid but (even when the test is properly performed) it has been demonstrated in a few rare cases of infection other than typhoid and in individuals who give no past history of typhoid fever. The test is then not an absolute one, yet when properly carried out a positive reaction may be considered reliable in a febrile disorder.

It is not yet possible to give the exact reason for the delay in onset or absence of there action in some cases of true typhoid infection, nor on the other hand can one always explain the rare cases in which the reactton has been demonstrated apart from typhoid infection. The delay in onset or the rarer absence of the reaction is generally explained by tissue pecularities a term hard to explain but one covering conditions well known to exist and of which we have a good example in the peculiar liability to tuberculosis of the children of phthisical stock. Perhaps a better example for the question under review is to be found in in the marked differences found between various horses in their

capacity of producing antitoxic serum against diphtheria when inoculated for this purpose. Some animals produce serum of very great potency, most of average potency, while a few produce serum of little antitoxic value. While the possibility of delay in onset must be considered yet a repeated negative result will be practically found to negative a typhoid infection. One must keep in mind here the possibility of the disease being in reality a paracolon (para-typhoid or typho-coloid) infection, a form of infection which very commonly accompanies epidemics of true typhoid.

The finding of the Widal reaction apart from typhoid is decidedly not common. Its presence may possibly be due to a previous infection with a persistance of the infecting agent. If notdue to such a cause it can only be ascribed to a natural over production of the agglutinative cellular material, or to such aproduction under a stimulus acting upon the tissue cells in the same manner as the typhoid bacillus. It should be kept in mind that such substances as alcohol, bichloride of mercury, carbolic acid and the like, will in small amount even, lead to a partial reaction so that the accuracy of the method used should always be inquired into in such a case. The finding of a complete reaction when proper dilutions are made and previous typhoid can be excluded are extremely rare. Many of the cases so far recorded have been with serum more concentrated than now generally employed in performing the test. The reaction to be complete requires that in the drop observed under the microscope, there must be loss of motility and grouping of the bacilli into distinct clumps or islands. A reaction should not be considered satisfactory if one finds clumps with numerous roving bacilli between the islands. Such a reaction is very suggestive (when technique is perfect) but it is better in such cases to secure a second specimen one or two days later for further examination before giving a definite opinion. It is mainly on the question of 'what constitutes a positive reaction?' that most difficulty in the interpretation of results has arisen. If one demands the full evidence of complete grouping and loss of motility one will never be wrong in pronouncing a febrile disorder typhoid.

The question as to the length of time which the agglutinins remain in the blood after typhoid is one of considerable interest and importance. There can be no doubt that in the majority of cases these bodies disappear fairly early. Widal says that in most cases good reactions cease to be obtained after 1st month of convalescence. Stewart, however, says that a reaction more or less complete can be obtained during first year in 50 per cent of all cases while in a few cases a reaction is found as late as 10 years. Most other authorities while agreeing with Stewart as to possibility of late reactions, find that good reactions are seldom found later than 6 months after the fever. In several cases which I have examined the reaction has been very feeble or entirely absent in from three to eight weeks. In my own case a good reaction is still found twenty weeks after febrile period, in dilutions of one in thirty inside sixty minutes. The reaction earlier in convalescence was present in lower dilutions (1-50) and appeared much sooner (five minutes). I have one case in my note books where a reaction was present eight years after the fever, The probabilities are in such a case that the typhoid bacillus has retained a lodgment in the body (gall bladder or urinary passages) and hence kept stimulating the formation of agglutinins. One can readily see that a persistent reaction might lead to an erroneous diagnosis if one depended mainly on the test.

Regarding the technique of the reaction, a short discussion of some of its points may be of some interest. I will consider 1st the method of securing the serum. In ordinary diagnosis one works almost entirely with the dried blood drop. This method is open to the objection that one cannot accurately estimate the necessary dilution requisite in carrying out the test, for in making the test properly the serum should be so diluted as to make the drop contain not more than one part in 20, some say 1 in 30 or 50. This dilution is necessary because most normal sera will when not diluted, or even with slight dilutions cause loss of motility in typhoid cultures and perhaps partial clumping. While strict accuracy cannot be obtained by the dried blood method, yet experience soon teaches the proper amount of diluting fluid to add to the dried blood drop, this being generally gauged by the color of drop which should be a

bright straw color. It is my practice to add 5 drops of sterile water or broth to a blood drop, mixing thoroughly and if not dilute enough adding sufficient more fluid to get requisite amount. Calculating half of the bulk of the dried drop is serum the addition of diluting fluid makes a dilution of 1 in 10 and as in the test this is mixed with at least an equal bulk of the typhoid culture the dilution of the drop examined is 1 in 20. In securing the drop the ball of the finger or lobe of the ear should first be cleansed with soap and water, then with alcohol and ether, the part being rubbed dry after the use of the latter. A puncture should be made, the first blood drop wiped away (clean absorbent) and after drops (3 or 4) taken a clean glass slide or piece of glazed paper the drops being kept separate and not too large. These drops are permitted to dry and are then ready for examination. The dried blood will keep days or even weeks without spoiling.

If one wants to study the reaction more carefully while using blood, so as to get approximately correct dilutions, a graduated bulbed pipette, e.g. the white corpuscle counting pipette of Thoma's haemacytometer can be used to collect the blood. The blood is drawn up in the long arm of pipette to required height and then drawn into mixing bulb with diluting fluid. In this way we can secure dilutions up to 1-200.

If one desires to work with the serum itself so as to secure accurate dilutions, a common bulbed capillary pipette can be employed, the blood being drawn up into the bulb until partially filled, the pipette is laid flat, and the blood coagulates on one side of bulb squeezing out the serum which can then be blown out. In this way several drops of clear serum can be secured for testing.

To obtain larger amounts of serum the best method is to apply a blister and then withdraw the blister fluid. This latter method takes time but secures a fair amount of material to work with, while excuses for the application of the blister on therapeutic grounds are not difficult to find.

The second point to be considered in the application of the test is the culture of the typhoid bacillus to be employed. Different strains of this bacillus vary in their response to this

test. A strain secured by me a few years ago from a Rockwood Hospital patient, dead of typhoid, has proven superior to several other strains isolated by me or secured from others. In making the test it is best to use an 18 to 24 hour old broth culture grown at 37 C the broth being inoculated from a stock agar tube which is replanted every fortnight. Some prefer to transfer from day to day from one broth culture to another, but after a few days it is best always to go back again to the stock agar culture.

The reaction will occur with a culture of bacilli which have been killed by heat, but of course we have no motility here to be lost and further the dead bacilli have a marked tendency to fall to bottom of containing tube and naturally tend to adhere more or less to each other. Dead cultures are practially never used in laboratory practice but would prove of value where cultures could not be carried on. The ordinary method of making the test is to mix a loop or ose of the diluted serum with a similar loop of the broth culture on a cover glass and their examine this in a "hanging-drop" preparation. This brings me to speak of the third and last point in the method, i.e., the reaction time. Frequently one finds the reaction develop at once so that it is present as soon as preparation can be placed under microscope. In other cases and particularly in low dilutions the reaction is slower and one can trace its gradual progress. In dilutions of 1 in 20 one hour is perhaps the outside time limit while in lower dilutions the time can be extended a second hour. I have rarely seen a true reaction develop after the first hour, though psendo-reactions are apt to develop at later periods so that all late reactions should be looked upon with some suspicion. Finally to speak of my own experience with this test which has been to a great extent limited by the fact that until this season we have had but little typhoid and when we had the typhoid the bacillus was subjecting me to its vagaries so that I could not make of the material afforded by the epidemic. However, I have use made examinations in 125 cases so far, of these 84 were positive and were clinically typhoid. In seven of these cases a second or third examination was made before the reaction became positive. Of the remainder 19 were undoubtedly not typhoid

and gave a negative reaction. Four which ran a typhoid course were examined but once, generally early in the infection, with negative results. One case gave a positive reaction and at autopsy one week later while intestinal lesions were present, these were not those characteristic of typhoid but were situated in sigmoid flexure and consisted of a few small ulcers resembling those produced by pressure of scybala (the clinical history previous to fatal illness was not available in this case), the fatal result was due to broncho pneumonia and I was unable to find the typhoid bacillus though the viscera were carefully examined. One other case was positive to Widal, but as patient died 36 hours after, with meningeal symptoms, the truthfulness of the reaction was called in question by several well known consultants. However, I have no doubt personally that the reaction was correct and that the meningeal symptoms were those of typhoid, ro a secondary infection in course of typhoid. The remaining 16 were all negative. Two of these patients died with meningeal symptoms, in both ascribed to typhoid infection. In one the reaction was looked for on three occasions, the other was examined but once, just before death, which occurred early in illness. The history of the last fourteen is unknown to me. They were only examined once and were generally specimens sent to me from outside where I could not follow the cases.

I cannot close without making a reference to the so called "typho-malarial" or "low" fever which was so prevalent last winter accompanying the epidemic of typhoid here. Most of the cases that I have had an opportunity of examining their clinical history had a febrile period of 8 to 14 days followed by convalescence. None of these cases examined by me gave the Widal, though probably some were cases of abortive typhoid. Others, the majority in fact were without doubt cases of the so called "paracolon" or "typho-coloid" fever, an infection due to a group of bacilli, intermediate in character between the typhoid and true colon forms, and which spread in exactly the same manner as the typhoid bacillus, viz.: through sewage (or excreta) infection of water and food supplies. I hope to have more to say on this condition at a later date.

W. T. Connell.

AN EPIDEMIC OF WATER-BORNE TYPHOID.

TO DAY there is no question as to the typhoid bacillus of Eberth being the actual and only cause of typhoid fever, nor yet is there any doubt but that it must enter via the mouth in food or drink in order that it may bring about the disease. As a carrier of the infective agent water readily takes the first place, the great majority of the cases in this country being due to it. Occasionally the disease is milk-borne, the milk becoming infected with the bacillus from contaminated water, or from the infected hands of milker, etc. Other foods may in like manner become infected chief among which may be placed, oysters, lettuce, water cress and the like. Food may become infected by flies or other insects which have previously been in contact with infected excreta. To this latter source several outbreaks in military camps have been traced in recent years. That typhoid is even air-borne remains yet to be proven. In this connection I wish to insist on the fact that sewer gas never is a direct cause of typhoid but only a potent predisposing factor.

The epidemic to which I wish to direct attention occurred in Kingston during this past winter, (1903). Typhoid fever has never developed as a distinct outbreak here since the water pipe was extended to its present position in the harbor. Isolated cases have developed in the city but comparatively few in residents using the public water supply, most cases being from the outskirts of the city where some wells are still to be found or are cases treated in the hospitals from country, all deaths occurring being returned in the city's records.

The case and death rates for the past five years will be found in Table I.

TABLE I.

Year.	Cases.	Deaths.	Mortality Percentage.
1898	8	4	50
1899	10	3	33.3
1900	18	4	22.2
1901	28	7	25
1902	17	4	23.5

During the first six months of 1903 there were reported 120 cases of typhoid fever, most of these being reported in February, March and April. The distribution of these cases according to monthly returns is shown in Table II.

TABLE II.

1903.	Cases.	Deaths.	Mortality Percentage.
January	11	2	
February	51	1	
March	26	7	11.6
April	26	3	
May	6	1	
June	0	0	
Totals	120	14	11.6

While the official figures for the outbreak are 120 cases, there were some undoubted cases that were not returned as such so that the death rate would not be as high as here stated. Besides the outbreak of true typhoid there was at the same time a large number of cases which our local physicians variously diagnosed under the headings of 'low', 'gastric', 'simple continued', 'bilious' or 'typho-malarial' fever. These cases were at least as numerous as the cases of true typhoid, the fever running from seven to twenty days the average duration being from between ten and fourteen days, the symptoms generally not being so severe, there being no rose spots and no marked intestinal disturbance. Some of these were probably abortive typhoid but the majority belonged to that ill defined group of fevers now known to be due to the "paracolon" forms of bacteria. These are propagated and carried in the same manner as typhoid, and are now recognized as frequently accompanying typhoid outbreaks as well as occurring apart from such.

Early in February a large percentage of the population especially those under thirty years were attacked by diarrhoea.

Thus amongst the medical students at Queen's over 80 were attacked during the first half of February. I am told that about the same proportions held among the students in the other faculties of the University. Only a small percentage of those seized with diarrhoea afterwards developed typhoid.

All three forms of infection were found widely distributed through the city, no quarter escaping. The rich as well as the poor were attacked, in fact the incidence of typhoid seemed greater in the better class houses. Suspicion for a time fell upon the milk supplied by a large dairy company, but the fact that the disease attacked as large a proportion of persons not supplied by this company as it did those supplied, soon negatived this idea. However the report did great damage to the business of the company, a damage that the company's officers say has not yet been recovered from. This left only the water as a general source of infection and to this, the health and water works officials then directed their attention, weeks too late however for the majority of the cases. I was unable myself to follow or take any part in the discussion of how the infection was being carried, as I was amongst those who went down with the severe outbreak occuring early in February when nearly one third of the victims of the epidemic were attacked. My personal oberservations were thus confined to the period after my convalescence and thus many matters which I would personally have inquired into were not investigated. The data on the physician's return card to the medical health officer (Dr. Fee), do not cover such points as the date of onset of illness or length of time sick before return was made. The return does ask the probable source of infection and the answer almost invariably given was "don't know." The health officials seemingly were in like plight and from the length of time it took them to get to work, their further motto probably was "don't care."

Owing to absence of data as to date of onset of illness in the series of cases it was out of the question to make a daily record and compare it with wind and weather conditions, and conditions detected by analysis of water.

Before taking up the various analyses of water which were

made, I will digress to speak of Kingston's water supply. Kingston obtains its water from the lake (Ontario), at a point (C), 2500 feet from shore (30 feet from bottom and from surface), as will be seen in accompanying map, (fig. 1). It was first proposed to take the supply from the point B, 1300 feet out from shore but the water there was found not to be any superior to that close in shore.

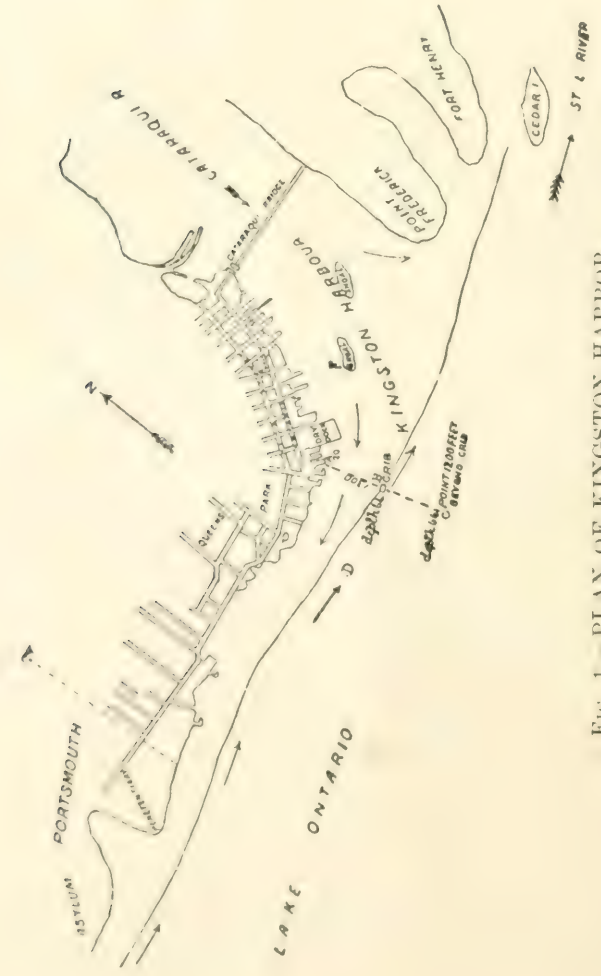


Fig. 1.—PLAN OF KINGSTON HARBOR.
Scale 4000 feet to an inch.

By the kindness of Prof. Goodwin I am able to give the following information regarding the currents in the harbor, (Water supply of Kingston. *Canadian Record of Science*, April, 1892). It might be well to add that previous to 1893 the water was taken from within 20 feet of shore at point A on map.

CURRENTS.

1. From the Asylum to near the point D, there is a steady current *down* the lake outside of a line averaging 700 or 800 feet from the shore.

2. Inside this line there is a variable eddy current *up* the lake.

3. The dividing line between the currents moves towards the shore with westerly, and away from it, with easterly winds.

4. From a point near D the dividing line runs in a general direction towards Cedar Island. It must often pass very near the crib (B), but its position is very much influenced by the direction and velocity of the wind.

5. Between the dividing line and the shore, the water of the harbor is comparatively still. The feeble currents are largely controlled by the wind. In quite calm weather there is however, near the waterworks, a slow current up the lake. On the whole, the harbor water may be considered to be, in comparison with the lake water, still-water.

These results explained the unexpected character of the water over the crib (B). The point is on the dividing line between the dead water of the harbor and the water moving down the lake. The water at this point is not so clear as that nearer shore, and has nothing to recommend it above the present city supply, (20 feet off shore).

Professor Goodwin has also furnished me the figures of the chemical analysis of our city water at various dates including some series made late in April, 1903, when the epidemic was practically at an end. These figures will be found in Table III.

TABLE III. (*Parts per million.*)

Date.	Free Ammonia.	Albumenoid Ammonia.	Chlorine.
January, 1893	.013	.09	5.2
July, 1894	.006	.074	5
April, 1901			4 to 6
April, 1903	.044	.111	5.6
April, 1903	.06	.122	5.7

The figures given for the analyses in 1893 and 1894 are looked upon by Professor Goodwin, as about the average analysis of our pure lake water. It will be seen at once that the analysis made late in April showed a water comparatively impure, there being an increase in all elements, the free ammonia being increased three to four times with a 25% increase in the albumenoid ammonia. The examinations made in April were so far as I know, the only local chemical examinations made. Previous to this however, samples had been sent to the Provincial Bacteriologist for chemical analysis. The earliest samples were sent on February 20th, and I append Dr. Amyot's figures in Table IV, with a contrast analysis of the Toronto public water supply.

TABLE IV. (*Parts per million.*)

Date.	Free Ammonia.	Albumenoid Ammonia.	Chlorine.
Feb. 20, 1903, No. 1	.035	.105	.4
Feb. 20, 1903, No. 2	.035	.115	.8
Toronto Water	.025	.075	.8

The analysis of Kingston water when compared with that of Toronto, did not make a bad showing to untrained observers in spite of the words of warning accompanying the report. In fact it did much to lull to rest the idea that the water supply was really at fault, in so far as the local authorities were concerned.

Regarding the bacteriological examination of the water, no analyses were officially made till February 24th, and later dates when samples were sent to the Provincial Laboratory. It is true that some desultory testing was done in my laboratory by some of the senior students in the second week of February which showed the water to contain colon like bacilli. Owing however to the inexperience of those testing and perhaps also to the fixed desire of the city officials, not to find anything wrong with the water, these results were entirely passed over.

I append in Table V, Dr. Amyot's reports on the samples submitted to him. Only those samples which would throw light on the water actually furnished the city and the water at intake, are included in this table.

One notes at once in the examinations made in March that the pump house tap water was inferior bacteriologically to that of the intake water, a piece of evidence pointing strongly to a break in the water pipe. About the same time as the second series of the above examinations were started I was able to return partially to work and instituted analyses of the laboratory tap water. In Table VI I give the results contrasted with previous analyses made of the city supply.

It will be noted that my results in the main confirm those of Dr. Amyot and show that the city water was undoubtedly contaminated with sewage bacteria. The bacterial analyses made in 1902 were in marked contrast to those of March, 1903.

On receipt of Dr. Amyot's reports and of the interpretation of them by Prof. Goodwin and myself, the waterworks committee examined the water pipe. At a point about 1300 feet out from shore near the point B in the map, a decided break was found in the pipe. The pipe at this point lies along the lake floor and had been caught by an anchor in October, 1902. After the failure of the ship's crew to raise it after repeated attempts, the cable was cut and the anchor left on pipe, the city authorities paying the vessel owners $35.00 therefor. No examination was made of the pipe to see what damage was done at the time and the result was an epidemic of typhoid and typho-coloid fever which cost the citizens many thousand dollars and the

TABLE V.

City No.	Date.	Source.	Colon Bacilli.	Colonoid B.	Strophylococci.	Streptococci.	Chlorine.	Remarks.
11	Feb. 27	Pump House Tap	None	None	None	None		26 bacteria per 1 cc
33	Mar. 4	Intake	"	Present				176 " "
2nd Series.	Mar. 26	Pump House	Present		Present	Present	6	
3	" 28	Intake	"		None	None	5	
4	" 28	Pump House	"		Present	Present	6	
1	" 30	" "	"		"	"	6	
2	" 30	Intake	None		None	None	6	
8	April 1	"	"		"	"		
9	" 1	Pump House	"	None	"	"		
10	" 6	Hotel Tap	"	"	"	"	5	
11	" 6	Pump House	"	"	"	"	5	
12	" 6	Intake	"	"	"	"	5	
13	" 8	"	"	"	"	Present	4	
14	" 8	Pump House	"	"	"	None	5	
15	" 8	" "	"	Present	"	"	4.5	
16	" 9	Intake	"	None	"	"	5.5	
17	" 9	Pump House	Present	Present	"	Present	5	

TABLE VI.

Date.	Colon B.	Colonoid B.	Streptococci.	Proteus Forms.	Fluorescent. Forms.	Subtiles Forms.	Remarks.
1902							
July 7	None	None	None	None	Present	Present	16 bacteria per 1 cc water
Dec. 10	"	"	"	"	"	"	8 " " 1 cc "
" 17	"	"	"	"	"	"	20 " " 1 cc "
1903							
Mar. 25	"	Present	"	"	"	"	80 " " 1 cc "
" 26	"	"	"	"	"	"	
" 27	Present	"	Present	"	"	"	240 " " 1 cc "
" 28	"	"	"	Present	"	"	
April 13	"	"	"	"	"	"	Water muddy, pipe being examined [by diver
May 2	None	None	None	None	"	"	
" 4	"	"	"	"	"	"	
" 6	"	"	"	"	"	"	
" 9	"	"	"	"	"	"	
" 22	Present	Present	"	"	"	None	(1) 600 cols. per cc (Pump house tap)
" 28	None	None	"	"	"	Present	(2) 32 cols. " " "
" 28	"	"	"	"	"	None	(3) 30 cols. per cc (Intake)
Aug. 27	Present	Present	"	Present	"	Present	(4) 80 cols. per cc (20 being colon)
" 28	None	"	"	None	"	"	
" 29	"	None	"	"	"	"	
Sept. 3	"	"	"	"	"	"	

1. Wind from East for 24 hours. 2. Wind from West and South West for 3 days. 3. Wind from West and South West for 3 days. 4. Laboratory tap water.

loss of 14 lives. When the diver was examining the pipe the citizens had evidence that there was a leak in the pipe for the water at the point of break being stirred up, muddy water was distributed over town. After the repair of pipe the epidemic entirely ceased though it was practically over before that date (May 6th). One might readily ask why it was that the epidemic did not break out sooner or why it stopped even before the break was repaired. On referring to the course of the currents already given, it will be seen that the point of break is near the "dead line" and it would only be when an east or north-east wind blew that there would be any danger of sewage passing over the break. (The prevailing wind here is from the south-west). After the harbor became frozen over there must have been some change in currents or these were influenced by the heavy inrush of water during the many thaws of last winter. In this connection I may say that there was a heavy thaw with much rain the last week in January and it was from ten to eighteen days after that about one-third of the total number were attacked. With the breaking up of the ice the effects of the prevailing south-west winds can again be seen. Add to this the effects of such precaution as boiling the water before use, etc., and the more careful disinfection of excreta, and we have the main factus in the disappearance of the infection. On examining Table VI one notes that the water even at present date, still shows at times infection with colon and colonoid organisms. This points either to an unrepaired or an impropely repaired leak in the pipe or else the water at the intake is occasionally infected. If so the infection probably comes from Portsmouth or the public institutions, the Penitentiary or Asylum for insane. At the present writing (Sept. 5th), both Portsmouth and the Asylum have typhoid cases. Our city has had one case of typhoid reported in July, (July 31st), and two in August one of which at least was in all probability infected outside the city. The question as so whether it is our city water which is causing the few cases which do crop up annually in our city is one of importance, and one which as yet neither our health officials nor our city waterworks committee have inquired into. It looks as if they had relapsed into their previous state of torpor

and were acting on the old saying, "Let a sleeping dog, lie." Before closing this paper I would like to point out the necessity for not relying on a chemical examination alone of water as evidence of its fitness or reverse. To illustrate by one case which came under my notice some time ago, a sample of water was sent me for chemical and bacteriological analysis, and report as to its fitness for drinking purposes. Prof. Goodwin made the chemical examination for me with the following results :

Total solids	127 parts per million.
Chlorine	6.7
Free ammonia	.006
Albumenoid ammonia	.057
Nitrates	Trace
Oxygen consumed in 15 mins.	.552
" " " 4 hours	.624

Odor slightly fishy.

This analysis does not show the water to differ from our ordinary St. Lawrence water in any respect excepting in the rather abnormally high amount of chlorine. In Kingston water this is only 5 parts per million.

(Signed.) W. L. Goodwin.

A microscopic examination of this water showed besides numerous bacteria, many diatoms, some vegetable detritus and numerous forms of animal life especially cryptomonas and certain rotifera, (anuriae).

On bacteriological examination the water was found to show 13,300 bacteria per 1 cc of which 240 were colon bacilli, 40 were proteus bacilli, the balance being B. fluorescens liquefaciens and a sarcina.

I learned afterwards that the water was taken from the side of a wharf about ten feet from shore and about seventy-five feet from the entrance of a drain, the current in which however did not set toward the wharf.

If the lesson which the epidemic has taught us, has not been learned in vain, then it has not been without some, even if expensive results. It teaches the necessity for purity as nearly as possible absolute in our water supplies, and it further

teaches us the necessity for a more careful disinfection of the excreta of typhoid cases which in our cases certainly was not done.

W. T. CONNELL.

DR. W. T. CONNELL

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Dr. Knight, who devotes all his time to University work, has charge of the Biological department, which includes Physiology and Histology.

Dr. W. T. Connell has charge of the departments of Pathology and Bacteriology, and in well equipped laboratories the students under his supervision study these subjects in a thoroughly practical manner.

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